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**Using Honey Bees
To Pollinate Crops**



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Using Honey Bees To Pollinate Crops

The honey bee is a most useful insect. In the United States alone, about 4.1 million colonies produce 150 million dollars' worth of honey and beeswax. While producing these unique and valuable products, honey bees also pollinate almost 19 billion dollars' worth of agricultural crops. In addition, they pollinate range plants, ornamentals, medicinals, spices, as well as trees and shrubs that provide food and shelter for wildlife.

Maximum yield and optimum quality of many commercially grown fruits, vegetables, and seed crops often require more insect pollinators than are naturally present in an area at flowering time. For this reason, about 10-15% of the colonies in the U. S. are rented by crop producers one or more times each year to assure an adequate level of pollination. The rest of the colonies generally supply pollination free as a byproduct of their honey-collecting activities.

Characteristics of Bees

Although many kinds of insects visit flowers in search of nectar and or pollen, only bees are important pollinators. Of the thousands of species of bees, only three are important pollinators of commercial crops. The alkali bee and the leafcutter bee are effective pollinators of alfalfa for seed in Washington, Oregon, Idaho, Nevada, and Utah. Because of their highly specific

nesting, foraging, and environmental requirements, their value is limited almost entirely to alfalfa and the five States mentioned. Other bees are either too few in number, or have too specialized food habits to be commercially valuable. Thus, honey bees provide about 80 percent of insect pollination service to crops. If it were not for them, yields from many of our crops would be uneconomical and quality would be substandard.

The honey bee is unusually well adapted for pollination. Each colony contains thousands of individuals which are available to forage for the food (pollen and nectar) that's required to rear their replacements. Like other bees, their sense of smell, eyes, mouthparts, and numerous branched body hairs are ideally suited for finding food sources, sipping nectar, and collecting and distributing pollen. Honey bees visit a wider variety of flower types than any other insect. In a single day, one bee makes 12 or more trips from the hive, visiting several thousand flowers. Yet on each trip, it usually confines its visit to one plant species, collecting one kind of nectar and distributing one kind of pollen. It has a complex communication system that makes the colony efficient in finding and collecting food with maximum efficiency. All these characteristics enable the honey bee to find and distribute an abundance of pollen and make it our most valuable agent for cross-pollinating crops.

Beekeepers maintain honey bee colonies in most agricultural areas, and are usually equipped to move colonies to any location where concentrated bee pollination activity is needed.

By M.D. Levin, research entomologist, Agricultural Research Service, Carl Hayden Bee Research Center, Tucson, Arizona; and reviewed by F.E. Westbrook, agronomist, Extension Service, U.S. Department of Agriculture, Washington, D.C.

Crops Pollinated by Bees

Some of the crops that require, or at least benefit from, bee pollination are listed below. The list is grouped for convenience and is limited to plants that contribute to our food supply. Trees, shrubs, and plants useful for other purposes are not included. Crops marked with an asterisk are often grown on such large acreage that the fields are stocked with colonies to provide adequate pollination by honey bees and thus are insured maximum yields and optimum quality.

Forage and Legume Crops

*Alfalfa; buckwheat; clover (alsike, berseem, crimson, Egyptian, *Ladino, *red, rose, strawberry, and white); *crown vetch; sweet clover (*Hubam, *white, *yellow); lespedeza (bush); *trefoil; vetch (*hairy and purple).

Fruit Crops

*Apple; apricot; *avocado; berry (blackberry, *blueberry, *cranberry, gooseberry, raspberry, and *strawberry); *cherry; citrus (*grapefruit, lemon), *mandarin, *tangelo, and *tangerine, mango, melon (*cantaloup, *casaba, citron, *honey dew, *persian, and *watermelon); nectarine; *peach; *pear; persimmon, *plum, pomegranates, and prune.

Nut Crops

*Almond, chestnut, coconut, and *macadamia.

Oilseed Crops

*Cotton, flax, *rape, *safflower, soybeans, *sunflower, tung.

Vegetable Seed Crops

Asparagus, *broccoli, *Brussel sprouts, *carrots, *cauliflower, celery, Chinese cabbage, collard, cucumber, dill, eggplant, garlic, kale, kohlrabi, leek, *lima beans, mustard, *onion, parsley, *pepper, pumpkin, *radish, rutabaga, *squash, and *turnip.

Renting Honey Bee Colonies

Honey bee colonies can be rented in many areas either from a custom pollination service or from a local beekeeper. In either case, it is wise to obtain a written agreement or contract that covers the following:

- Number and strength of colonies to be used.
- Time of delivery and removal.
- How the colonies will be distributed in or around the field.
- Right of entry for beekeeper to service his colonies.
- Access to bees, assured water supply, irrigation schedules.
- Degree of protection from pesticides that will be given to the bees.
- Plan of payment of the rental fees.
- Conditions required to break the agreement.

Using Strong Colonies

Since there is no set number of honey bees in a colony, one needs to know about differences in colony strength before renting bees for pollination. Colony strength refers to the number of bees in the hive. This can be estimated by the area of inside hive surfaces that is densely covered by bees. This can vary with the season of the year, temperature,

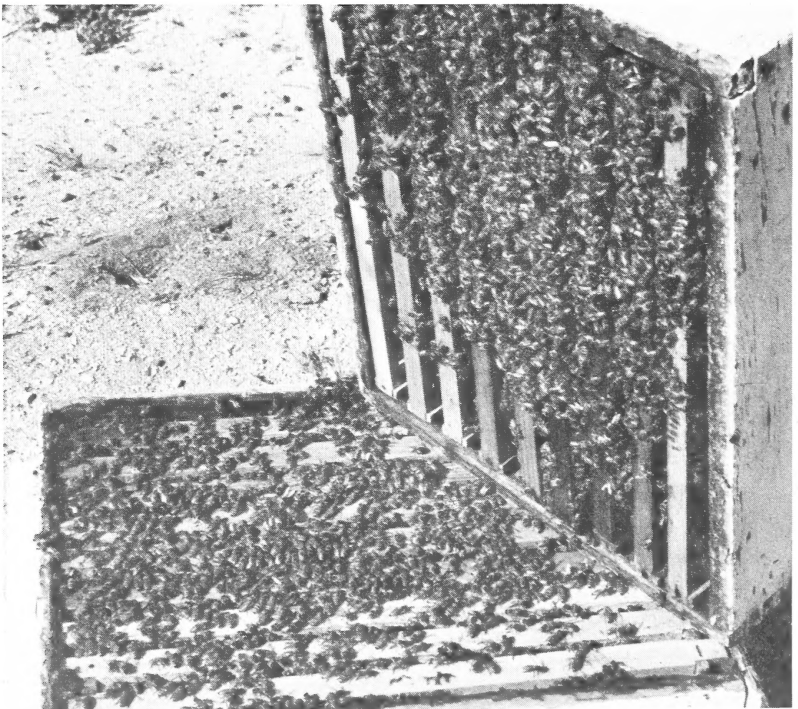
and the number of sections (super, story, hive body) to the hive. A deep hive body will contain from 13,000 to 20,000 bees. At the higher number, when the hive is opened, bees will quickly appear to "boil over" and cover the tops of the frames.

Recommendations made in this bulletin for a given number of colonies per acre are based on strong colonies in hives of two or more stories for late spring or summer crops. These should contain 25,000 bees in 16 to 18 frames and brood on at least 6 to 12 frames. Very early in the season, a single-

story hive, or one with one deep plus one shallow section, can contain enough bees and brood to get the job done. While most beekeepers can be relied upon to supply strong colonies, it makes sense to check that colonies being rented are strong. Weak colonies at bargain prices are a poor investment. They may not pollinate the crop effectively; therefore, yields and quality may suffer.

Estimating Colony Strength

In some States, it is possible to get help in evaluating colony strength from county or State bee inspectors.



A reasonably strong two-story colony of honey bees.

In other States it may be possible, with the beekeeper's agreement, to hire a knowledgeable hobby or side-line beekeeper to examine the rented colonies. If these options are not available, the beekeeper should, as part of the agreement, open hives in the presence of the renter.

In good weather, the number of bees flying at each hive entrance should be about the same. Fewer bees at the entrances of some hives may indicate weaker colonies. A better evaluation can be made by opening the hive and counting the number of frames covered with bees. This is accomplished by tipping the hive body and looking up from the bottom. Each frame will hold 1,300 to 1,500 bees. The best evaluation can be made if the frames are removed so that the brood can be seen as well as bees. Good-sized patches (hand palm or larger) of brood, well covered with bees on each of 5 to 12 frames, will ensure the need for pollen and an adequate supply of replacement foragers.

Number of Colonies to Use

Because of the wide variety of conditions that can exist in any area, it is not possible to state the precise number of bees that will be needed. The number of honey bees necessary depends, primarily, on the number of natural pollinators already in the area and the number of other flowering plants (crops or weeds) that may attract pollinating insects. Also, the attractiveness of the crop, the number of flowers per acre, the number of acres to be pollinated, duration of the bloom period, and anticipated weather conditions are factors that can affect the number of bees needed.

The following list, developed from research data and field experience, shows the minimum number of strong honey bee colonies needed to pollinate crops under typical conditions.

<i>Colonies per acre</i>	<i>Crops</i>
1 to 2—	Cherries, melons (cantaloup, watermelon, etc.); peaches, tangelos, tangerines, squash, apples, clover (alsike, crimson, ladino, white); pears, trefoils, sweetclovers, vetch (purple, hairy); cucumber, sunflowers, and cotton.
3 to 4—	Alfalfa, almonds, carrots, blueberries, cranberries, onions, and red clover.

Colony Distribution in the Field

Honey bees usually visit flowers more thoroughly within 100 yards of their hives than they do flowers at greater distances when bloom period is short or good flying weather is not reliable. To get the best coverage, and the most efficient pollination, the honey bee colonies should be placed in groups throughout large fields or orchards at about 0.1 mile (500 feet) intervals.

Whenever bees are moved to a new location, they go through a 3-to 5-day orientation period as they get acquainted with their new surroundings. During this period, they tend to pollinate flowers closer to their hive, often limiting their foraging area to a 50-to 100-yard circle. As time passes, this gradually extends to several hundred yards if sufficient forage is available. If not they will seek nectar and pollen sources as far as they have to go to find

them, up to 2-3 miles. Obviously such distances are not conducive to efficient foraging or pollination; so colonies are usually placed as close as possible to the crop to be pollinated.

Where access to a field or an orchard is not feasible, or in a field of less than 40 acres, the groups should be placed along the outside borders of the field. If the field or orchard is more that 500 feet across, the groups at the center of the borders should have more colonies, thus increasing the pressure on foragers to extend deeper within the field than they might otherwise go.

There is evidence that better pollination is obtained when the bees departing from their hive can head upwind towards the crop; so placing the colonies downwind from the crop is helpful.

The following list gives the number of colonies to be placed in each group for a given number of colonies per acre. For example, groups at 500 feet intervals should contain seven colonies for one colony per acre.

<i>Colonies per acre</i>	<i>Colonies per group</i>
1.....	7
2.....	13
3.....	20
4.....	26

Scheduling Delivery of Colonies

The delivery of honey bee colonies should be timed to coincide with the blooming period of the crop to be pollinated. This may vary according to elevation, latitude, season, temperature, moisture, and species or variety. As a general rule,

it is best if the colonies are not brought to the field or orchard until some bloom is present. This will reduce the likelihood that the bees will start to work on other flowers and not find the target crop when it starts to flower. In large acreages of crops that gradually reach full bloom, like alfalfa, the bees can be brought into the fields with two moves over a 10-day period.

Removal of colonies can be scheduled as the crop sets, and the number of flowers remaining to be pollinated will be reduced. Colonies can, of course, remain after the need for pollination has passed as long as they present no problem to the farmer and are not vulnerable to pesticide hazard. The timing of colony removal should be as much a subject for negotiation as colony delivery.

Pollenizers

Many varieties of fruit trees and some other plants produce no fruit when pollinated with their own pollen. They must be cross-pollinated. Trees that must be cross-pollinated require pollen from other closely related fruit varieties. Some can be pollinated only by pollen from particular varieties.

Plants that must be cross-pollinated include all varieties of almond, chestnut, and sweet cherries; certain citrus fruits, most varieties of apple, pear, plum, prune, and blueberries; and a few varieties of peaches and apricots.

The varieties that produce suitable pollen for cross-pollination are called pollenizers. These must be planted where bees will visit their flowers, as well as the flowers of the varieties

that must be pollinated, on a single flight. Pollenizers usually are interspaced between trees of the main variety.

When appropriate pollenizer trees are not planted properly, other methods of supplying the needed pollen can be used. One substitute for trees is to graft branches of pollenizers to trees of the variety that must be pollinated. Grafts should be located where bees are most likely to visit—sheltered from prevailing winds, but exposed to the sun.

At times, carefully preserved hand-collected pollen can be placed in a pollen dispenser in the entrance of a beehive. Bees leaving the hive will come in contact with the pollen and carry it to the flowers they visit. Reports on the use of pollen dispensers indicate that their use has not been consistently successful and often they are not recommended.

To keep commercial pollen potent, follow all directions for its proper care. Hand-collected pollen is expensive and is generally used only as a last resort to get the plants pollinated.

Bees also are used to pollinate male-sterile plants that have been developed for mass producing hybrid seed of several bee-pollinated crops.

Bees carry pollen from selected male-fertile plants to cross-pollinate the flowers of the male sterile plants.

Some bee-pollinated hybrid crops are cucumber, onion, and squash. To produce these crops, every third to fifth row is planted to the male parent; the remaining rows are planted to the female parent. Similar methods are being developed for producing hybrid seed of cotton, melon, safflower, and some other field crops. In general, the bees are used on these crops the same way they are used on the other crops mentioned in this leaflet, although more colonies may be required to overcome the natural tendency of bees to work down the rows instead of across the rows.

Pesticide Danger to Bees

Pesticides are the single most serious problem to beekeeping in agricultural areas. Many crops must be protected from insect pests and diseases, but they must also be pollinated by bees.

For further information on protecting bees from pesticides, consult your county or State Extension agent or your county or State bee inspector.

